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ABSTRACT

Recent research has clearly indicated that intoxication with alcohol impairs memory. The present study investigated the effects of alcohol on retrieval from long-term memory by using a set of cognitive decision tasks. Subjects (N=24) were female college students in good health not taking oral contraceptives. Subjects were administered 0 or 1.0 ml/kg body weight of absolute alcohol (vodka) diluted in a lemonade and peppermint masking solution. After time for alcohol absorption, subjects made physical, lexical, and semantic decisions about pairs of words. Intoxicated subjects responded significantly more slowly than placebo subjects for the lexical and semantic decision, although there were no alcohol effects observed in reaction times. These results suggest that alcohol-induced memory defects may be the result of a slower rate of cognitive operations on the part of intoxicated subjects that impairs the efficiency of their working memory operations. (References are included.) (Author/ABL)

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The Effects of Alcohol on the Speed of Memory Retrieval

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ABSTRACT

The present study investigated the effects of alcohol on retrievial from long-term memory by using a set of cognitive decision tasks. Subjects were administered 0 or 1 ml/kg of alcohol, and then made physical, lexical, and semantic decisions about pairs of words. Intoxicated subjects responded significantly slower than placebo subjects for the lexical and semantic decisions. The results suggest that alcohol induced memory deficits may be the result of a slower rate of cognitive operations on the part of intoxicated subjects that impairs the efficiency of their working memory operations.

Recent research has clearly indicated that intoxication with alcohol impairs memory. Several studies suggested that the memory deficits observed result from a disruption of the encoding operations involved when attempting to store new information, but retrieval of previously learned information is unimpaired (Birnbaum & Parker, 1977; Parker, Birnbaum & Noble, 1976; Birnbaum, Parker, Hartley & Noble, 1978). Subsequent research suggested that the encoding disruptions resulted from an inability of intoxicated subjects to engage in deep or elaborate processing as effectively as sober subjects, resulting in difficulties in integrating new material in working memory (Hastroudi, Parker, DeLisi & Wyatt, 1983; Petros, Kerbel, Beckwith, Sacks & Sarafolean, 1985). One mechanism that may underlie this impaired integration might be that alcohol slows the rate at which cognitive operations occur. For example, Moskowitz and Roth (1971), using a naming task, reported that alcohol intoxication resulted in an 11.5% increase in the time necessary to access the names of words from memory. One problem with Moskowitz and Roth's study is that it only examined the speed of accessing the name of a word from memory. One purpose of the present study was to examine the effects of alcoholic intoxication on the speed of accessing the physical features of words, the name of a word, and categorical information about a words. Several studies suggested that accessing categorical information took longer than accessing information about the name of a word or the physical features of a word (Rosch, 1975). Therefore, if alcohol slowed the rate of cognitive operations, the size of the alcohol effect should increase as more information needs to be accessed about the words.

A second problem with the work of Moskowitz and Roth (1971) is that they failed to differentiate the time necessary to execute the motor response in their naming task from the time required to access long-term memory. The present study included a procedure to separate the cognitive and motoric

components of the response. Thus, the general objective of this study was to examine the effects of alcohol on retrieval from long-term memory of physical, lexical, and categorical information about words.

Additionally, this study was undertaken to assess the effects of alcohol on cognitive operations of female subjects. Women have been largely ignored as subjects in alcohol research; however, there is increasing evidence that women may be affected differently by alcohol than men (Jones and Jones 1976a, 1976b, 1977). Consequently, the present study examined the effects of acute intoxication with alcoholic on the speed of memory retrieval in women.

METHOD

Subjects

Twenty-four female college students aged 21- 35 who were not taking oral contraceptives served as subjects. All subjects were screened prior to their participation to determine that they were in good health, and that their past drinking histories revealed that they would be able to tolerate the dose of alcohol administered in the study.

Materials

Twenty-four words were chosen from eight different categories, and each of the words were highly typical examples of their category (Rosch, 1975). Each experimental session consisted of three blocks of 32 trials, with each block consisting of 16 positive and 16 negative trials. Positive trials presented the same word twice in the same typeface (cat/cat), the same word twice in a different typeface (cat/CAT), or two different words from the same semantic category (DOG/cat). Each type of positive trials occured alone in one of the three blocks of trials. All of negative trials involved two words from different semantic categories (cat/peach). The specific typefaces occured equally often for both positive and negative response types within each block of

trials. The word pairs were presented to the subject on an Apple IIe computer.

Procedure

Each subject was tested during the first five days of her menstrual cycle. After a set of predrinking practice trials, subjects were administered 0, or 1.0 ml/kg body weight of absolute alcohol (80 proof vodka) diluted in a lemonade and peppermint masking solution. The dose was consumed in two twenty minute drinking periods, followed by a fifteen minute absorption period (i.e., Birnbaum et al., 1978). Subjects then received a brief set of practice trials followed by a set of experimental trials for each of the three decision types. The subjects were instructed to decide whether the two words were physically identical, had the same name, or belonged to the same semantic category. The specific type of positive decision was announced before each block of trials began. Subjects were told to respond by pressing one of two computer keys as quickly as possible without making errors.

The experimental trials were followed by a sequence of reaction time control trials, in which the word pair was removed from the computer screen after a 3 second delay. Subjects were told to respond as quickly as possible after the words disappeared from the screen. The words were displayed on the computer screen for a period of 3 seconds because it was assumed that memory access would be completed during this time, and the subsequent response time would only reflect the time needed to execute the motor component of the task.

RESULTS

Each subject's median response time was computed for each cell of the design for both the experimental and reaction time control trials. Furthermore, the reaction time control data was subtracted from the corresponding cell of the experimental design, resulting in a set of difference scores. All response times on trials where an error occured were excluded from the analysis. The

response times were subjected to a 2(treatment) x 3(decision type) x 2(response type) mixed analysis of variance. All significant effects were observed with $p < .05$. Table 1 presents the mean RTs for experimental trials, reaction time control trials, and difference scores between these two measures.

Significant main effects of treatment, $F(1, 22) = 11.890$ and response type, $F(1, 22) = 4.716$, were observed. Intoxicated subjects responded more slowly (mean = 914.256) than the sober subjects (mean = 553.030), and subjects responded more quickly to positive decisions (mean = 710.459) than to negative responses (mean = 756.827). A significant main efffect of decision type, $F(2, 44) = 79.143$, was observed along with a significant treatment by decision type interaction, $F(2, 44) = 7.294$. A subsequent Neuman-Keuls analysis revealed that alcohol subjects responded significantly slower than placebo subjects for the lexical and semantic decisions. Specifically, intoxicated subjects were 39.4% slower on physical decisions (PI), 83.3% slower on name decisions (SN), and 67.5% slower on semantic decisions (SC) than the sober subjects.

The 2(treatment) x 3(decision type) x 2(response type) mixed analysis of variance on the median reaction time control data revealed no significant differences. A 2(treatment) x 3(decision type) x 2(response type) mixed analysis on the median difference scores (median experimental RT minus median reaction time control RT) was identical to the pattern of results yielded from the analysis of the median experimental RTs as reported above (see Table 1). In short, there were main effects of treatment, $F(1, 22) = 11.89$; and response type, $F(1, 22) = 4.72$; and decision type, $F(2, 44) = 79.14$; and a significant interaction between treatment and decision type, $F(2, 44) = 7.29$. The error data were also analyzed by a 2(dose) x 3(decision) x 2(response) mixed analysis of variance, which revealed a significant main effect of decision type, $F(2, 44) = 15.607$. Significantly more errors were made on the semantic decisions

(mean = 8.5%) than on both the physical (mean = 2.9%) and lexical decisions (mean = 3.9%). The physical and lexical decisions did not differ from one another in the number of errors made by subjects.

DISCUSSION

These results revealed that intoxicated subjects were slower than sober subjects in retrieving information from long-term memory. They also demonstrated that the size of the alcohol induced slowing became greater as more information needs to be accessed from the words. These effects are not simply due to alcohol slowing the motor response involved because there were no alcohol effects observed in the reaction time control data, and the pattern of results on the experimental trials was the same as that observed in the difference score analysis. The similar pattern of results observed on the error-rate data and on the experimental data suggested that no speed/accuracy trade-offs existed in the data. This suggests that the response time differences were not due to strategy changes in the way intoxicated subjects performed the task.

Alcohol induced memory impairment may be the result of a slower rate of cognitive operations on the part of intoxicated subjects as evidenced by their increased difficulty making more complex decisions about words than sober subjects. This would impair the efficiency with which they can carry out operations in working memory. As a result, they would fail to integrate or elaborate information in working memory as efficiently as sober subjects (Hastroudi et al., 1983; Petros et al., 1985).

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Table 1
Mean Response Time and Error Rate as a Function of Dose and Decision Type.

	PI	SN	SC
Experimental Trials			
Alcohol	901.385 (0.041)	1185.769 (0.048)	1731.885 (0.091)
Placebo	690.727 (0.017)	805.545 (0.031)	1167.772 (0.079)
Reaction Time Control Trials			
Alcohol	369.192 (0.048)	366.346 (0.019)	340.731 (0.087)
Placebo	308.954 (0.017)	358.636 (0.017)	337.364 (0.028)
Difference Scores			
Alcohol	532.192	819.423	1391.154
Placebo	381.772	446.909	830.409

Note: Error rates are shown in parentheses. PI refers to physically identical decisions, SN refers to same name decisions, and SC refers to same category decisions.